OSU Working Papers in Linguistics, 1-11

One-Step Raising in Gbanu*

Mary M. Bradshaw

§0. Introduction

This paper presents data from the Gbanu language which illustrates one-step raising of vowels. This vowel raising poses serious challenges to feature models in which vowel height is represented with the features [high], [low] and [ATR]. On the other hand, feature models in which vowel height is represented by a uniform feature arrayed on different tiers handle the same data in an elegant fashion.

In many vowel feature geometry models (Odden 1991, Sagey 1986), vowel height distinctions can be made only with the features [high] and [low]. Furthermore, [ATR] can be used as a kind of alternate height feature when a vowel system has more than 3 heights. The models using these features account adequately for most height harmony phenomena. For example, Odden (1991) accounts for height harmony in Kimatuumbi which is illustrated in (1)[1]. Notice that the causative suffix alternates according to the height of the root vowel. When the root vowel is a high vowel [*u, i*], the causative suffix contains the high vowel [*i*], as in *ut-iy-a* 'to make pull'. When the root vowel is [*ʊ, ɪ*], the causative vowel is [*ɪ*], as in *ɣʊɣʊʊt-ɪy-a* 'to make whisper'. When the root vowel is a mid vowel [*ɛ, ɔ*], the causative vowel is [*ɛ*], as in *gɔɔnj-ɛy-a* 'to make sleep'.

* Thanks go to D. Odden for helpful comments and discussion.

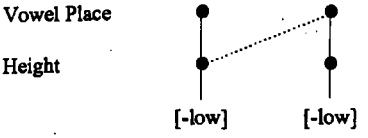
[1] The languages in this paper are tone languages but tones are left unmarked as they are irrelevant to the vowel phenomena discussed here.

(1) Kimatuumbi Height Harmony of the Causative Suffix /iy/ (Odden 1991)

ut-a	'to pull'	ut-iy-a	'to make pull'
yib-a	'to steal'	yib-iy-a	'to make steal'
yʊyʊʊt-a	'to whisper'	yʊyʊʊt-ɪy-a	'to make whisper'
bɪɪk-a	'to put'	bɪɪk-ɪy-a	'to make put'
gɔɔnj-a	'to sleep'	gɔɔnj-ɛy-a	'to make sleep'
chɛɛng-a	'to build'	chɛɛng-ɛy-a	'to make build'
kaat-a	'to cut'	kaat-iy-a	'to make cut'

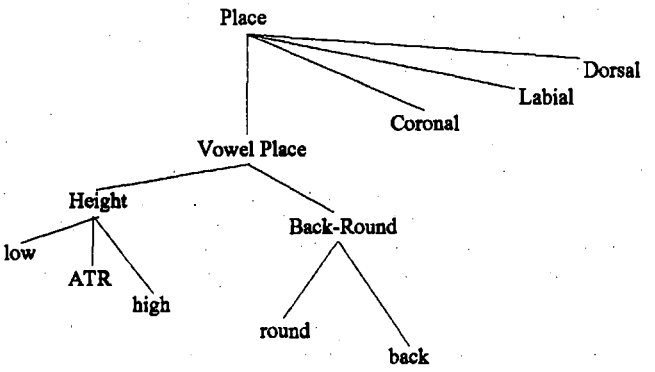
Odden (1991) accounts for these data, as in (2), where the Height node spreads when it is specified as [-low]. It is necessary to specify the trigger and target as [-low] since the low vowel [*a*] fails to spread and is opaque to spreading.

(2) Kimatuumbi Height Harmony



Odden's model for vowel features is given in (3). Note that by the height harmony process given in (2), what is spreading are the [high], [low] and [ATR] features. (Terminal features under the Vowel Place node are binary, although not so marked in (3).)

(3)



While this model handles height harmony like that of Kimatuumbi quite nicely, it is seriously challenged by a height process which involves one-step raising.

§1. One-Step Raising in Gbanu

In Gbanu, a Gbaya language of the Niger-Congo family spoken in the Central African Republic (group 1, Ubangi branch of Adamawa-Ubangi subfamily), the phenomenon of one-step raising characterizes the Perfective form of the verb (Monino, c1993). Gbanu has 7 vowels and 4 degrees of vowel height. In a model like that of Odden 1991, these vowels would be specified as in (4) where height distinctions are made in terms of [high], [low] and [ATR].

(4) Feature Specifications in the Odden 1991 Model

	i	u	e	o	ɛ	ɔ	a
high	+	+	-	-	-	-	-
low	-	-	-	-	-	-	+
ATR	+	+	+	+	-	-	-
back	-	+	-	+	-	+	+
round	-	+	-	+	-	+	-

The Perfective in Gbanu is indicated by a change in the root vowel, which surfaces as one step higher in the Imperfective. The Imperfective and Perfective forms of Gbanu verbs are shown in (5). When a root has a high vowel */i, u/*, that vowel surfaces unchanged in the Perfective, as in *gunu* 'has buried' from */gun/*. When a root has a mid vowel */e, o, ɛ, ɔ/*, that vowel is raised one-step. The high-mid vowels */e,o/* become [*i, u*], as in *hile* 'has cried' from */hel/* and *tumbo* 'has sent' from */tombl/*. The low-mid vowels */ɛ, ɔ/* become [*e, o*], as in *zekɛ* 'has sifted' from */zɛk/* and *ɲoŋɔ* 'has eaten' from */ɲɔŋ/*. When a root has a low vowel */a/*, that vowel, like the high vowels, surfaces unchanged in the Perfective, as in *hana* 'has fried' from */han/*. The disyllabic verbs show that the phenomenon occurs across a consonant, and not just when vowels are adjacent.

(5) Gbanu Perfective and Imperfective Verbs[2] (Monino c1993)

	Imperfective		Perfective		Imperfective		Perfective	
/i/	6i	'gather'	6ii	'has gathered'	lifi	'make net'	lifi	'has made net'
	pi	'throw'	pii	'has thrown'	?ili	'push'	?ili	'has pushed'
	gi	'cook'	gii	'has cooked'				
/u/	ku	'cross'	kuu	'has crossed'	dunu	'is full'	dunu	'was full'
	6u	'make a circle'	6uu	'has made a circle'	gunu	'bury'	gunu	'has buried'
	lu	'make...	luu	'has made boule'				
/e/	fe	'die'	fie	'has died'	zele	'hear'	zile	'has heard'
	?e	'put'	?ie	'has put'	hele	'cry'	hile	'has cried'
/o/	lo	'fall'	luo	'has fallen'	tombo	'send'	tumbo	'has sent'
	kpo	'knot'	kpuo	'has knotted'	dolo	'forge'	dulo	'has forged'

[2] Underlining indicates nasalization.

/ɛ/	dɛ	'do'	dɛɛ	'has done'	hɛlɛ	'tie'	helɛ	'has tied'
	pɛ	'seed'	pɛɛ	'has seeded'	zɛkɛ	'sift'	zekɛ	'has sifted'
/ɔ/	dɔ	'burn'	dɔɔ	'has burnt'	gɔmɔ	'chop'	gomɔ	'has chopped'
	kɔ	'want'	kɔɔ	'has wanted'	ɲɔŋɔ	'eat'	ɲoŋɔ	'has eaten'
/a/	ba	'take'	baa	'has taken'	hana	'fry'	hana	'has fried'

As illustrated in (6), the vowel raises only when the underlying root vowel is high-mid or low-mid. The Imperfective forms, like the Perfective forms, are derived from an underlying CV or CVC root. The CV forms surface as CV in the Imperfective (but CVV in the Perfective). The CVC forms surface as CVCV in both Perfective and Imperfective. Consonant-final underlying representations are assumed in spite of the surface CVCV forms because all disyllabic verbs in Monino's Gbanu data have identical vowels in both syllables. Furthermore, all verbs in Gbanu are vowel-final. Given a constraint against coda consonants[3], the surface forms are accounted for with a repair strategy by which a vowel is inserted in the Imperfective and the melody of the root vowel spreads to fill it. No such vowel insertion is necessary in the Perfective because a floating mora is suffixed as part of Perfective formation and it is filled in by the same vowel spreading operative in the repair strategy.

(6)			
	high	/Ci/ → [Cii]	/Ci C/ → [CiCi]
		/Cu/ → [Cuu]	/CuC/ → [CuCu]
	high-mid	/Ce/ → [Cie]	/CeC/ → [CiCe]
		/Co/ → [Cuo]	/CoC/ → [CuCo]
	low-mid	/Cɛ/ → [Cɛɛ]	/CɛC/ → [CeCɛ]
		/Cɔ/ → [Cɔɔ]	/CɔC/ → [CoCɔ]
	low	/Ca/ → [Caa]	/CaC/ → [CaCa]

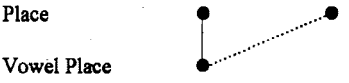
The patterns given in (6) represent only the underlying form and the output of the phonology. But the derivation of the surface forms resulting from one-step raising in Gbanu actually involves several steps. First, an empty mora is suffixed to the root (CeC → CeCμ). Evidence for this comes from CV verbs which take the form CVV in the Perfective, such as *ba* 'take' which becomes *baa* 'has taken'. Clearly, a mora has been added. Moreover, the quality of the second vowel depends on the quality of the first vowel. They are identical for high or low vowels and differ only by one degree of height for mid vowels. Thus, in all vowels within a single verb, the Place features are identical. This indicates that there is spreading of the root vowel (CeCμ → CeCe). Finally, the root vowel must be raised one-step (CeCe → CiCe). Any account must deal with these processes (mora insertion, spreading, raising). Furthermore, any account must deal with the apparent failure of the high and low vowels to raise.

[3] Coda constraints are the norm in the Gbaya group of languages.

§2. Vowel Feature Geometry of Odden 1991

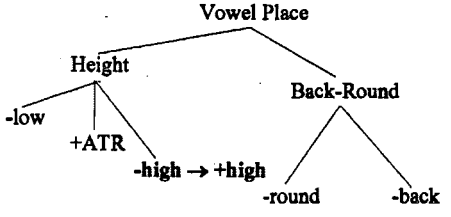
How would a model like Odden 1991 handle this phenomenon? In (7), the vowel spreading process is represented within Odden's model. Vowel spreading is triggered by the insertion of the Perfective suffix, an empty mora. Note that spreading must occur at the level of the Vowel Place node because it occurs across consonants and involves all the vowel features. The features [round] and [back] are used as place features.

(7) Vowel Place Spread



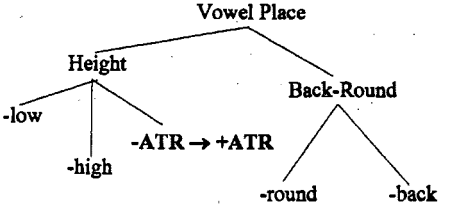
Subsequently, vowel raising affects the root vowel. Vowel raising in this model can be conceived of as morphologically sensitive processes that affect only Perfective forms. In (8), the operation that turns a root vowel */e/* into [*i*] in the Perfective is shown to be the result of some process which effects a feature change in the value of [high]. This is not necessarily a feature changing rule. It could equally well be an insertion rule that involves an automatic delinking of the original high specification.

(8) Vowel Raising fe → fie 'has died'



Compare this to (9), where the change from */ɛ/* to [*e*] in the root vowel involves a change in the feature [ATR], whether by feature change or feature insertion.

(9) Vowel Raising dɛ → deɛ 'has done'



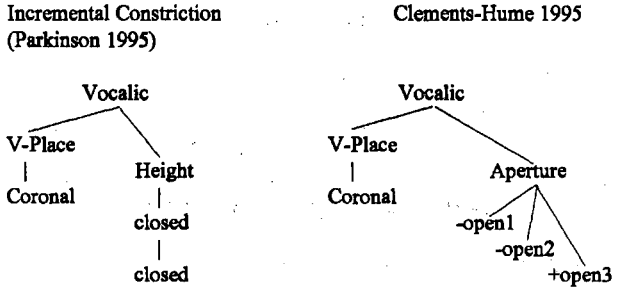
The process illustrated in (8) must target only high mid vowels, and the process illustrated in (9) must target only low mid vowels.

There are some problems with this approach. What happens to the root vowel in the Perfective, namely raising one-step in height, cannot be captured in a unified manner. It must be considered a change in the feature [high] for some vowels and a change in the feature [ATR] in others. Thus, two separate processes are required: one for high mid vowels and another for low mid vowels. Moreover, the generalization that the root vowel raises one-step in height is not captured. What we have is merely a feature change which changes different features for different target vowels. Furthermore, we have to stipulate that the processes involved occur only in the Perfective. In this approach, we would have a Perfective ATR process and a Perfective Raising process. Thus, the vowel feature model in Odden 1991 fails because it does not use a uniform phonological feature to account for the uniform phonetic dimension of vowel height.

§3. Other Vowel Feature Geometry Models

Other vowel feature models, such as the Incremental Constriction model of Parkinson (1995) and the model of Clements and Hume (1995), represent vowel height in terms of a uniform feature arrayed on different tiers. These models, given in (10), show the geometry from the Vocalic Node (the part relevant for vowel features) for the vowel [*e*]. I will assume the Incremental Constriction model, but both models appear capable of handling the Gbanu data.

(10) Representations of [*e*]



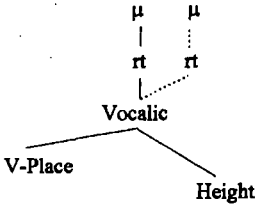
In Parkinson's Incremental Constriction model, the features of Gbanu's vowels are specified as in (11). The high vowels [*i,u*] are characterized by three [closed] features. The high-mid vowels [*e,o*] are characterized by two [closed] features. The low-mid vowels [*ɛ,ɔ*] are characterized by one [closed] feature; and the low vowel [*a*] would have no [closed] feature.

(11) Features of Vowels in Incremental Constriction Model

	i	u	e	o	ɛ	ɔ	a
closed	•	•	•	•	•	•	
	•	•	•	•			
	•	•					
Labial		•		•		•	
Coronal	•		•		•		

In order to derive the attested surface forms, a process of vowel assimilation, in (12), spreads the Vocalic node of the root vowel to the empty mora of the Perfective morpheme. Intervening consonants will not block this spreading. This will result in an intermediate form with two root nodes that shares the vowel features found under the Vocalic node. The root node of the affix is interpolated when the Vocalic node spreads. This structure differs from that of a long vowel in which one root node is shared by two moras.

(12) Vocalic Spreading (in this case to the Perfective morpheme)



Spreading results in the multiple linking of all the vowel features of the root and suffix vowels. Yet raising affects only half of the multiply linked structure. That is, it affects only the root vowel. This can be dealt with by a process of cloning, as in (13). Cloning consists of a separation of one multiply linked structure into two featurally identical singly linked structures (see Cohn 1990:56-57 and Hume 1992:118-119). It typically affects vowels which do not share the same root node. Cloning allows a process to affect the root vowel without affecting the suffix vowel. Thus, spreading causes the features in the root and suffix vowels to have the same feature specifications, and Cloning allows subsequent rules to affect one of these vowels without affecting the other one.

(13) Cloning

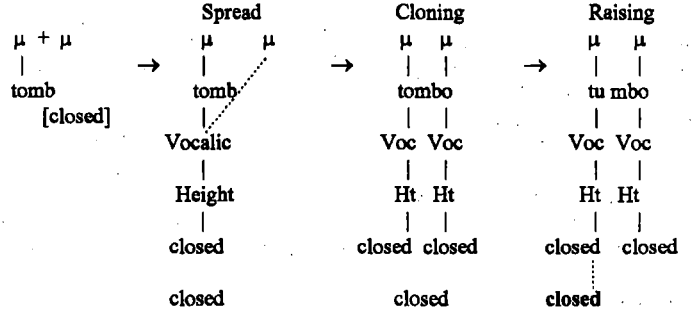
The vowel raising phenomenon that is the focus of this paper is accounted for by a floating [closed] feature that attaches to the root vowel. This [closed] feature is part of the Perfective morpheme. The process, given in (14), is simply a mapping process. It docks the floating feature to the leftmost [closed] feature by left to right mapping. Because of the mapping process, the feature [closed] is mapped to the leftmost linked [closed] feature, migrating across the feature specifications for the suffix vowel. Thus, the Perfective morpheme is a suffix consisting of a mora and a floating [closed] feature.

(14) Root Vowel Raising/Closed Insertion

Note that this process automatically excludes low vowels which have no [closed] features. This corresponds to a weak crosslinguistic generalization that when a vowel has height features, it generally has place features as well. Since [*a*] is a Placeless vowel in Gbanu, and an underlyingly Heightless vowel, it cannot acquire height features.

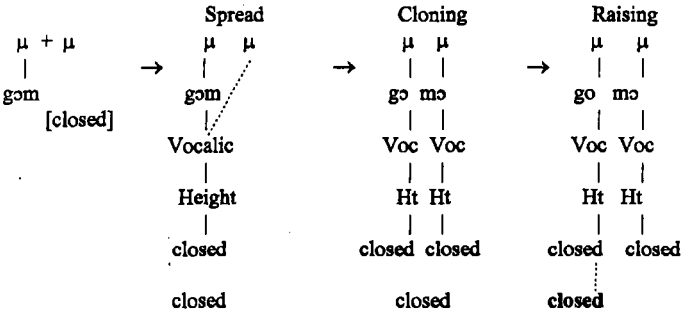
In (15) and (16), derivations involving high mid and low mid root vowels are compared. Notice that unlike with the Odden 1991 feature model, these analyses are identical. In (16), */tomb/* becomes [*tumbo*] in the Perfective. First, the Perfective morpheme, consisting of a floating mora and a floating [closed] feature, is affixed. Then, Vocalic Spreading takes place, followed by Cloning. Raising results from the mapping of the floating [closed] feature to the terminal [closed] feature of the root vowel.

(15) tomb → tumbo 'has sent'



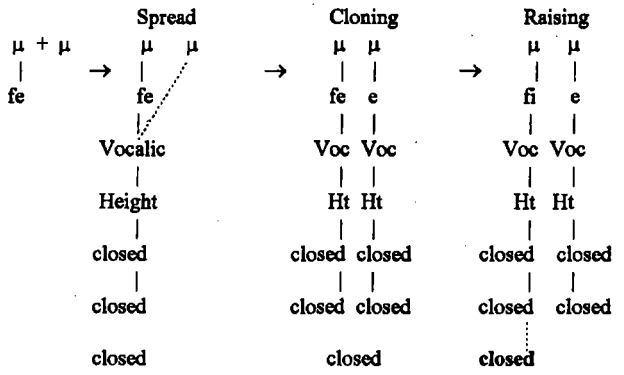
The same procedure results in */gɔm/* becoming [*gomɔ*] in the Perfective, as shown in (16). The fact that the target vowel is low mid rather than high mid does not require any new process, or any modification of the procedure whatsoever.

(16) gɔm → gomɔ 'has chopped'



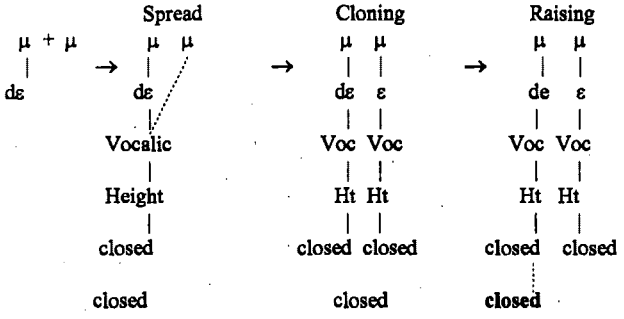
The same process applies for a verb in which no consonant intervenes between the root vowel and the suffix vowel, as shown in (17) and (18). The derivation is the same as those in (15) and (16) for verbs with intervening consonants. In (17) the derivation is shown for a CV verb with an underlying high-mid Coronal vowel.

(17) fe → fie 'has died'



In (18), the derivation is shown for a CV verb with an underlying low-mid Coronal vowel.

(18) dɛ → dɛɛ 'has done'



A feature model such as the Incremental Constriction model, which appeals to privative stacked vowel height features, has a number of advantages when used for an analysis of one-step raising. In this model, the phenomenon can be handled in a unified manner. All mid vowels undergo the same raising. Low vowels are excluded by the form of the mapping process. High vowels can either be excluded by structure preservation, or the raising can be applied vacuously. Basically, no higher vowels are available in the language either phonologically or phonetically. The generalization that root vowels are raising one degree is captured. Finally, the process can be seen as a simple mapping of an element of the Perfective morpheme to the root in question.

§4. Conclusion

Vowel feature models which use [high], [low] and [ATR] to distinguish vowel height have been criticized because they can only capture four degrees of height and because [ATR] is masquerading as a height feature when it is really something else (Clements & Hume 1995). These models can also be criticized for the problems they have in handling the phenomenon of one-step raising such as that found in the Perfective in Gbanu.

Vowel feature models, like the Incremental Constriction Model (Parkinson 1995), in which a uniform height feature is arrayed on different tiers have the advantage of being able to handle one-step raising elegantly. Thus, the one-step raising found in Gbanu provides additional support for this kind of model.

REFERENCES

Clements, G. & E. Hume. 1995. The internal organization of speech sounds. The Handbook of Phonological Theory, ed. by J. Goldsmith, 245-306. Cambridge: Blackwell.

Cohn, A. 1990. Phonetic and phonological rules of nasalization. Los Angeles, CA: University of California dissertation.

Hume, E. 1992. Front vowels, coronal consonants and their interaction in nonlinear phonology. Ithaca, NY: Cornell University dissertation.

Monino, Y. c1993. Proto-gbaya, Essai de linguistique comparative sur vingt et un parlers d'un groupe de langues oubanguiennes. Paris: Paris V dissertation.

Odden, D. 1991. Vowel geometry. Phonology 8.261-289.

Parkinson, F. 1995. A formal account of Romance metaphony. Paper presented at the Montreal-Ottawa-Toronto Workshop on Phonology, University of Ottawa.

Sagey, E. 1986. The representation of features and relations in nonlinear phonology. Cambridge, MA: MIT dissertation.